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DESIGN FOR RETAINING WEALTH FROM EXCREMENT

Mr. D. Arivukkarasu
Asst. Professor, Dept. of Civil Engineering,
GRT Institute of Engineering and Technology, Tiruttani, Tamilnadu

A.Seyad Abu Thahir Aasif, M.R.Vijay, M.Arunraj and M.R.Udhaya Kumar
IV Year Students, Dept. of Civil Engineering,
GRT Institute of Engineering and Technology, Tiruttani, Tamilnadu

ABSTRACT

In our daily life each and every minute waste water is generated, but the thing is it is not disposed properly. Hence it results in pollution and creates number of unfavorable impacts on environment and human beings. On the other hand the sources of pure water gets reduced day by day due to disposal of untreated water later they may become extinct. Hence it is necessary to get a thorough knowledge in waste water treatment. Our project deals with the study of sewage disposal of a village and designing of various sewage treatment units to treat the sewage disposed. Meanwhile possible ways to use treated water effectively is analyzed When sewage is treated effectively they are capable of satisfying electricity demands and their by products can be used as manure.

Key words: Generation of Sewage, Improper Disposal, Impacts on Environment, Sewage Treatment Units (Design), Possible Ways, Electricity Demands, Manure.

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1. INTRODUCTION

1.1 General

India is a developing country which requires self sustainability in every field to run high in success path. Our nation should develop a lot in waste disposal and sanitary

facilities. Each and every minute of life time very generate waste water but we are not disposing them safely hence it results in pollution and causes serious impact on our environment. On the other hand often this sewage water is allowed to mix with pure water sources and makes them extinct. According to our taught we came to a conclusion this may result in serious demand for drinking water. Hence when we start to treat sewage water we may get dual benefit such as utilization of waste water and saving pure water from contamination. Meanwhile effective treatment of excrement may help us to satisfy electricity demands, agricultural demands etc., the by products of treatment units can be used as manure.

1.2. Location of Our Site

Name of the Areas: Savattur, Thiruvalluvar Nagar and Pudur.

Name of the Village:	Podhattur pet
Name of the Taluk:	Pallipet
Name of the District:	Tiruvallur
Location of the site:	Latitude $13^0 16'58.8''$ N
	Longitude $79^0 29'2.4''$ E

1.3. Reason

The pond in the above mentioned location is polluted due to disposal of sewage waters over a period of 5 years. Hence we have selected this as a study area. In our project we have studied about the quantity and characteristics of sewage generated in the above mentioned areas and designed various treatment units to treat them before disposal, on the other hand we have also planned to research the possible ways to utilize the treated water to satisfy agricultural demands and other demands including drinking water demand. Meanwhile we have studied whether the treatment units can be also utilized for satisfying electricity demands and the by products of the treatment units can be used as manure.

2. LITERATURE SURVEY

2.1. Ortiz Escobar M E and Hue N V

Organic farming uses almost exclusively biological and natural and produce food. The practice aims to protect human health and conserve, maintain (or) enhance natural resources, with the goal to preserve the quality of the environment for future generations while being economically sustainable. Organic farming has grown rapidly throughout the world in recent years .Currently, Australia (Oceania) has the largest land areas under organic farming, Liechtenstein (Europe) the highest percentage of organic area and Mexico (Latin America) the greatest number of organic farms worldwide. One of the most valuable benefits of organic farming is the improvement in soil quality, which can be expressed in terms of chemical, physical and biological properties and their interaction. In this article, we will discuss the properties, regulation and impacts of organic farming on human livelihood and the environment.

2.2. Ramachandra Murthy K, Anand C and Manjuprasad C

The present paper examines the performance of trends of agriculture growth and production in India. And also the paper has shown the growth and production has significantly increased from during the last three decades and also highlight the

performance of the Indian agriculture growth is also increased over the period of time the present paper mainly focused on the secondary sources with help of the statistical tools such as mean, standard deviation, covariance, regression methods has been used for study purpose.

2.3. Richa Rai, Madhu Rajput, Madhoolika Agrawal and Agrawal S B

Air pollution receives one of the prime concerns in India, primarily due to rapid economic growth, industrialization and urbanization with associated increase in energy demands. Lacks of implementation of environmental regulations are contributing to the bad air quality of most of the Indian cities. Air pollutants produced in any air shed are not completely confined, but at time trespassing all the geographical boundaries, hence do not remain only a problem of urban centres, but spread and effect remote rural areas supporting large productive agricultural land.

Air pollutants pose risks on yield of crops depending on the emission pattern, atmospheric transport and leaf uptake and on the plant's biochemical defence capacity. Recent trends have shown decrease in SO_2 emissions, but increase in NO_2 emission due to more number of automobiles. In past few decades, tropospheric 0_3has been identified as a most important air pollutant of rural areas. Air pollutants produce reactive oxygen species (ROS), which adversely affect biochemical processes of plants and reduce their tolerance capacity to other stresses also. Several vital physiological processes such as photosynthetic. CO_2fixation and energy metabolism are also affected negatively by air pollutants. An adverse effect caused by air pollutants depends not only upon its concentration, but also on the duration and combination of air pollutants. The present review deals with present and future trends of major gaseous pollutants emissions and their impact on crop performance.

3. METHODOLOGY

3.1. Execution of Methodology

Step- 1: Data Collection

Population of 2015 - Direct visit to site

Population of 2005&1995 - Internet

Step- 2: Layout

Layout of area - Top sheet map & CAD drawing

Layout of treatment unit (Line diagram) - CAD drawing

Step- 3: Population Forecasting

Future population of 2025, 2035 and 2045 are estimated

Step- 4: Generation of Sewage

Based on the estimated future population amount of sewage generation is found out.

Step-5: Design of Treatment Units

Based on the amount of sewage generated the following sewage treatment units are designed sewer line.

1. Bar screen

2. Grit chamber
3. Sedimentation tank
4. Trickling filter
5. Sludge drying beds

Step- 6: Drawing Of Treatment Units

Based on the dimensions obtained in design calculations, the design drawings of treatment units are made using Auto CAD software

3.1.1 Data Collection

Table 3.1 Population Data of Podhatturpet (1995-2015)

YEAR	POPULATION
1995	700
2005	1003
2015	1750

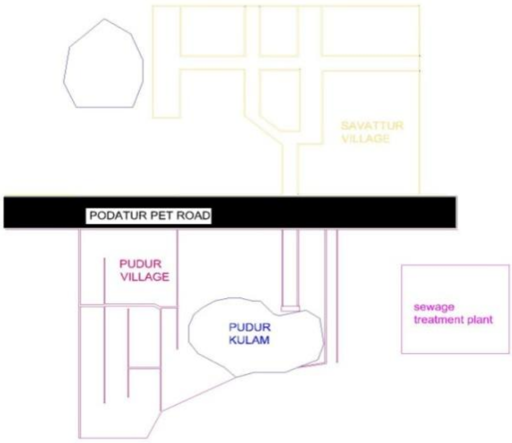

Figure 3.1 Layout of Our Project Site

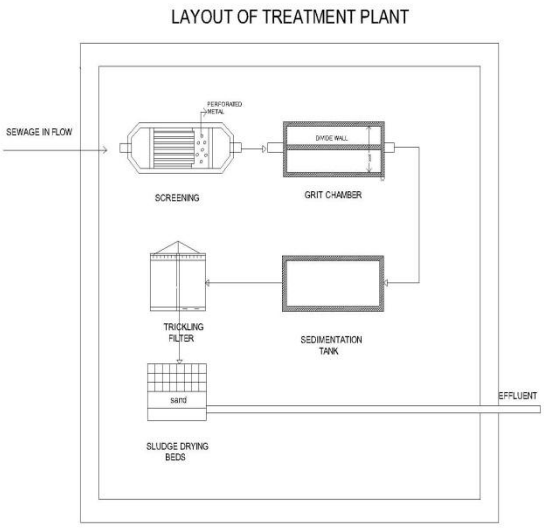

Figure 3.2 Line Diagram of Our Treatment Plant

3.1.2 Population Forecasting

Based on the population data collected from various sources we can estimate the future population with the help of some formulas available for forecasting.

METHODS OF POPULATION FORECASTING

1. Arithmetic Increase Method
2. Geometric Increase Method
3. Incremental Increase Method
4. Simple Graphical Method
5. Decreasing Rate Method
6. Comparative Graphical Method
7. Master Plan Method
8. The logistic Curve Method

METHODS USED

From the above methods, 3 methods have been used for population forecasting and the average value is taken as future population.

1. Arithmetic Increase Method
2. Geometric Increase Method
3. Simple Graphical Method

AVERAGE FORECASTED POPULATION

With the help of forecasted population values by above 3 methods, the average forecasted population values of various years are

Forecasted population of the year 2025 =2285

Forecasted population of the year 2035 =3173

Forecasted population of the year 2045 =4500

4. RESULTS AND DISCUSSION

4.1. Dimensions

4.1.1. Diametr of the Sewer

Population = 4500

Area of the village = 40.1 Hectare

Average rate water supplied = 110 MLD (S.K.Garg, Pg.No. 10)

Sewage Flow = Avg. rate of water supplied × Population × 0.8

= (110 × 4500 × 0.8) / (24 × 60 × 60 × 1000)

= 0.00458 m^3/s

Max. Sewage flow = 0.00458 × 3

(Assume peak factor = 3)

= 0.0137 m^3/s

Mannings N= 0.013 (S.K.Garg, Pg.No. 44)

Slope i = 1/400

$Q = A \times V$
$0.0137 = ((\pi/4) \times d^2) \times (1/N) \times R^{(2/3)} \times S^{(1/2)}$
$0.0137 = ((\pi/4) \times d^2) \times (1/0.013) \times (d/4)^{(2/3)} \times (1/400)^{(1/2)}$
$0.01143 = d^2 \times d^{(2/3)}$
$d = 0.186$ m

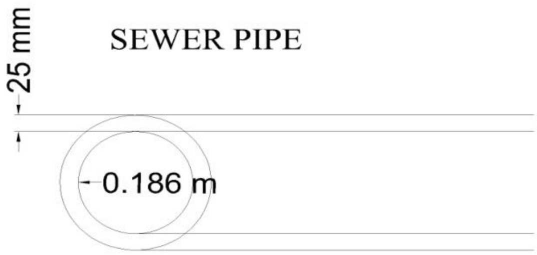

Figure 4.1 Design Detailing of Sewer Line

4.1.2. Design of Bar Screen

Assumptions,
Angle of screen bars = 60^0 to the horizontal
The size of the bar is 10 × 50 mm with 10 mm facing the flow of sewage
The bars are placed at 50 mm clear spacing
Velocity through screen = 0.8 m/s (S.K.Garg, Pg.No. 44)
Total sewage flow = 0.0137 m^3/s
The net area of screen opening (A_n) = Q_{max}/V
= 0.0137/0.8
$A_n = 0.017\ m^2$
E_g = Clear spacing / (Clear spacing + Thickness)
= 50 / (50 + 10)
= 0.83
Gross area $A_g = A_n / E_g$
= 0.017 / 0.83
= 0.0248 m^2
Gross area required for inclined screen,
$A_{inc} = A_g / \sin 60^0$
= 0.0248 / Sin 60^0
= 0.0286 m
$V_c = Q_{max} / A_g$
= 0.0137 / 0.0248
= 0.554 m/s
Head loss $h_L = 0.0729 (V_s^2 - V_c^2)$
$= 0.0729 (0.8^2 – 0.554^2)$

= 0.0244 m

When screen gets half clogged then the velocity through the screen is multiplied by 2

Now @ half clogged V_s = 2 × 0.8

= 1.6 m/s

Head loss $h_L = 0.0729\,(1.6^2 - 0.554^2)$

= 0.164 m

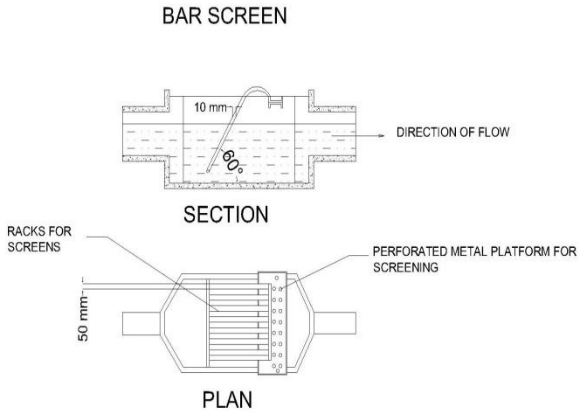

Figure 4.2 Design Detailing of Bar Screen

4.1.3. Design of Grit Chamber

Maximum rate of flow = 0.0137 m^3/s

Velocity of flow = 0.2 m/s

Detention period = 60 s

(Range (40 – 60 s), S.K.Garg, Pg.No. 251)

The length of the tank = Velocity of flow × Detention time

= 0.2 × 60

L = 12 m

Provide three detritus tank for sewage flow

Discharge in each tank = 0.0137 m^3/s

Cross sectional area of the tank = Discharge / Velocity

A = 0.0137 / 0.2

= 0.069 m^2

Assuming a water depth of 1 m above the crest of the weir, which is kept at 0.3 m above the channel bottom, we have the width (B) of the basin as,

Width of the tank = Cross sectional area / Depth

= 0.069 = 0.1 m (Approx)

Overall depth of the grit chamber (D) = 1 + 0.3 + 0.45

= 1.75 m

Size of the tank = 12 × 0.1 × 1.75 m

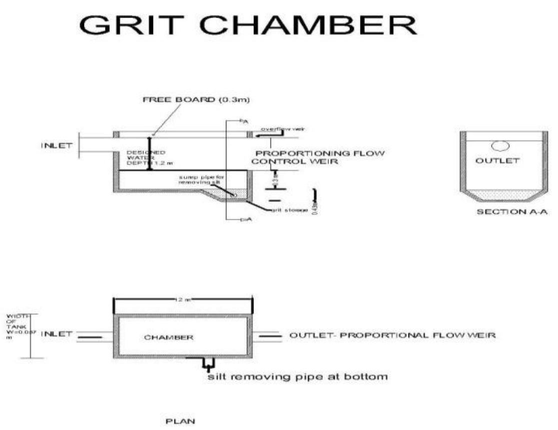

Figure 4.3 Design Detailing of Grit Chamber

4.1.4. Design of Sedimentation Tank

Total sewage generated
= 0.0137 m^3/s or 1183.68 m^3/day
Type of the tank = Rectangular
Detention period = 2 Hrs
Overflow rate V_s= 30 $m^3/day/m^2$
Length to Breadth ratio = 4:1
Capacity of the tank = (Sewage flow × Detention period)/24
= (1183.68 × 2) / 24
= 98.64 m^3
Surface area A = Q / V_s
= 1183.68 / 30
= 39.45 m^2
Effective Depth d = Capacity of the tank / Surface area
= 98.64 / 39.45
= 2.5 m
Dimensions of the tank A = L × B
39.45 = B × 4B
B = 3.2 m
L = 3.2 × 4
= 12.8 m
Provide additional 4 m for inlet and outlet arrangements
L = 17 m
Provide additional 1 m depth for sludge accumulation and 0.5 m for free board
Overall depth D = 2.5 + 1 + 0.5 = 4 m
Dimensions of the tank = 17 × 3.2 × 4 m

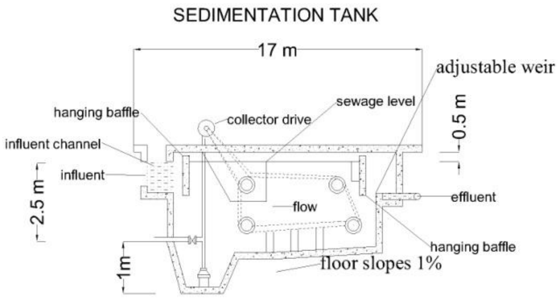

Figure 4.4 Design Detailing of Sedimentation Tank

4.1.5. Trickling Filter

As per IS: 8413 (Part 1) -1977 Requirements for biological treatment equipments,

Trickling filters are also called as percolation or sprinkling filters of tank of filter media. The filter media may be of crushed stone (or) slag of larger size over the filter media the sewage is allowed to sprinkle (or) trickle down by means of spray nozzle (or) rotary distributor. The percolating is collected at the bottom of the tank through a well designed under drainage system

Consider high rate trickling filter

Sewage flow = $0.0137 m^3/s$ or 1.18368×10^6 /day

BOD of sewage = 100 mg/l (as per IS 3306-1974)

Total BOD sewage present in sewage to be treated per day

= $1.183 \times 10^6 \times 100$

= 118 kg/day

As per code book the value of organic loading may be taken as 1500kg/hectare meter/day (i.e between 900 to 2200 kg/ha-m/day) and then the hydraulic loading 22 to 44ML/ha/day

The volume of filter media required = 118/1500 =0.0786 ha-m

= $786 m^3$

Using circular trickling filter of diameter 20m, we have the number of units required

= total area/area of one unit

= $393/(\pi/4(20^2))$

= 1 no

Check for hydraulic loading

The surface area of the filter bed required can also be worked out by assuming the value of hydraulics loading say as 35 million liters per hectare per day (i.e. between 22to 44 ML/ha/day)

Surface area required = Total sewage to be treated per day/ Hydraulic loading per day

= 1.18/35 hectares

= $337 m^2$

The surface area chosen is 393 m^2, which is greater than 337 m^2 and hence safe Hence 1 unit of 20 m diameter and 2 m effective depth can be adopted. An extra second unit as standby may also be constructed.

To find efficiency of filter

Recirculation ratio = 1.5

(As per code book, range 1-4)

Efficiency = $100/1+0.0044\frac{\sqrt{Y}}{VF}$

= $100/ (1+0.0044\sqrt{118}/ (0.0786F)$

F = $(1+R) / (1+0.1R^2)$

= $(1+1.5) / (1+0.1\times1.5)^2$

= 1.89

Efficiency = 88.9%

DESIGN OF ROTARY DISTRIBUTORS

Sewage flow = 0.0137 m^3/s

Assuming that the velocity at peak flow is 2m/s through the central column of the distributor, the diameter of the central column

$=\sqrt{0.137/2} \times \sqrt{1/ (\pi/4)}$

= 0.1 m

Provide central column of 0.1 m in diameter, but check the velocity through the column at average flow, as it should not be less than 1m/s or so.

CHECK FOR FLOW VELOCITY THROUGH THE CENTRAL COLUMN AT AVERAGE FLOW

Discharge through each unit at avg. flow = 0.0137 m^3/s

Velocity at avg. flow = $0.0137/ (\pi/4 \times 0.1^2)$

= 1.74 m/s

Hence Safe

Design of arms

Now, let us use rotary reaction spray type distributor with 4 arms

The discharge per arm = 0.0137/4

= 0.00345 m^3/s

Diameter of filter used = 20 m

Arm length = (20 - 2)/2

= 9 m

We can use arm of 9 m length with its size reducing from near the central column towards the end. The three sections each of 3 m length

From the central column, Allowing 0.2 m diameter in center to be used for central column, etc.., these areas would be: Let A_1, A_2,A_3 be the circular filter areas covered by each length of arm , starting

$A_1 = \pi (r_2^2 - r_1^2)$

$= \pi (3.1^2 - 0.1^2)$

$A_2 = \pi (6.1^2 - 3.1^2)$

$= 30.15m^2$

$A_3 = \pi (10^2 - 6.1^2)$

$= 197.261m^2$

Total area $A = \pi (10^2 - 0.1^2)$

$= 314.12 \text{ m}^2$

Proportionate areas served by each section of arm are worked out as

$1_{st} = A_1/A$

$= 30.15/314.12$

$= 9.6 \%$

$2_{nd} = A_2/A$

$= 86.7/314.12$

$3_{rd} = A_3/A$

$= 197.261/314.12$

$= 62.7 \%$

Now, full discharge through an arm i.e. 0.0137 m^3/s, will flow through the first section, and this will go on reducing through the second and third section

Design of first section

Assuming velocity through the arm as 1.2 m/s we have

The area required = 0.0137/1.2

$= 0.114 \text{ m}^2$

Diameter required = $\sqrt{(0.114/ (\pi/4))}$

= 0.38 m or 380 mm

Design of second section

Discharge through the second section = (100 - 9.6) % × 0.0137

$= 0.0128 \text{ m}^3/s$

Area required = Q/V

= 0.01238 /1.2

$= 0.0103 \text{ m}^2$

Diameter required = $\sqrt{(0.0103 / (\pi/4))}$

= 0.114 m or 114 mm

Design of third section

Discharge through the third section = (100 - 9.6 - 27.7) % × 0.0137

$= 0.0198 \text{ m}^3/s$

Area required = Q/V

= 0.0198 /1.2

$= 0.0165 \text{ m}^2$

Diameter required =√ (0.0165 / (π/4))

= 0.145 m or 145 mm

The entire arm length kept as the 380 mm diameter

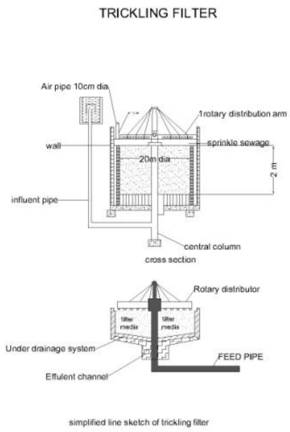

Figure 4.5 Design Detailing of Trickling Filter

4.1.6. Sludge Drying Beds

Drying of the digested sludge on open beds of land is called sludge drying beds.

Population = 4500

The sludge content per capita = 0.036 kg (S.K.Garg, Pg.No 325)

The moisture of the sludge = 70 %

Specific gravity of the wet sludge = 1.02

C = 0.036 × 4500

= 162 kg/day

70 % of moisture content means 30 kg of dry sludge will produce 100 kg of wet sludge

30 kg of dry sludge produce = 100 kg of wet sludge

162 kg of dry sludge produces wet sludge = 100/30 × 162

= 540 kg

= 0.54 ton/day

Volume of wet sludge produced = mass of sludge/density of sludge

= 0.54/1.02

= 0.52 m^2/day

The area of beds required = 0.52/.225

= 2.31m^2/day

Under tropical Indian conditions, the bed get dried out in about 10 days and hence taking 2 weeks average drying time including wet days of rainy season , we can utilize the same bed

= 52/2

= 26 times in a year

Area of bed required = 2.31 × 365/26

= 35 m^2

Making 100 percent allowance for space for storage, repairs and resting of beds

The total area of beds required = 2 × 35

= 70 m^2

Now using 15 × 30 m beds, the no. of beds required

= 70/ (15 × 30)

=1 bed

Area of each bed = 70 m^2

Using 7m width of each bed

Length of each of bed = 70/7

= 10 m

Hence use 1 bed of size 15 m × 10 m in plan. The beds should be provided with under drains and side walls with typical section and plan

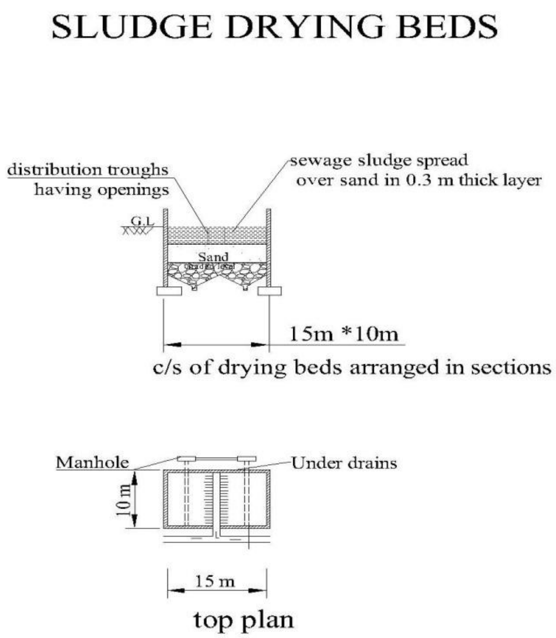

Figure 4.6 Design Detailing of Sludge Drying Beds

4.2. Utilization of Treated Water

The effluent got from the treatment plant can be taken as 75 % of the influent supplied

Influent supplied per day = 1.18 MLD

Effluent received per day = 0.88 MLD

Amount of water required to irrigate 1 acre

In case of vegetables = 5000 litres / day

In case of tree plants = 12000 litres / day

Hence with the help of treated water,

In case of vegetables = 176 acres can be irrigated

In case of tree plants = 73.33 acres can be irrigated

The sludge got in this project is a fine organic manure and be used for organic farming.

Waste is a waste until it is utilized

The treated water, and sludge becomes wealth when they are retained with the help of various treatment units.

5. CONCLUSION

Thus we conclude that the characteristics of various treatment units of sewage treatment plant are studied. Based on the characteristics and amount of sewage received from the concerned site sewage treatment units are designed.

The units are designed economically based on the limit state and working stress design concept.

These units are utilized to treat the sewage before disposal and hence impacts on environment and human beings are reduced. On the other hand effluent received can be used for irrigation purpose. Hence this project is an eco friendly project for farmers.

The by products can be used as manure. On further development of this project can help to meet electricity demand.

Thus we can achieve **"GREEN ENVIRONMENT".**

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